AMENDMENTS TO THE DRAWING

Appended hereto as an attachment is a replacement formal drawing sheet to replace the drawing sheet that was included in the published PCT application. The PCT drawing sheet has been amended to delete the PCT application and publication numbers, as well as the "SUBSTITUTE SHEET (RULE 26)" designation, and to add the identifier "Fig. 1" and reference numeral 9.

Also appended hereto is a copy of the published PCT drawing showing in red the amendments that are reflected on the attached replacement drawing sheet.

REMARKS

The substitute specification together with the amended claims and drawing place the present U.S. national phase application in better form for examination on the merits.

Also attached hereto is an Abstract of the Disclosure presented on a separate sheet in conformity with the rules of practice.

Based upon the specification, drawing, and claim amendments to this national phase application, it is believed that the amended specification and amended drawings and claims conform with U.S. formal requirements. Additionally, the amended claims as hereinabove presented conform in substance with the corresponding amended claims that were examined in the international application. And based upon the acceptance by the International Preliminary Examining Authority of the invention as it was claimed in the amended claims that were presented in the international application as meeting each of the novelty, the inventive step, and the industrial applicability criteria set forth in the Patent Cooperation Treaty, the claims as amended above are believed to conform with both U.S. formal and U.S. substantive requirements, and they are therefore believed to be in allowable form. Accordingly, an early Notice of Allowance is in order and is respectfully solicited.

Should the examiner have any question after considering this Preliminary Amendment, he is cordially invited to telephone the undersigned

attorney so that any such question can be quickly resolved in order that the present application can proceed toward allowance.

Respectfully submitted,

December 24, 2005

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Attachments: Attachment A
Attachment B
Abstract of the Disclosure
Annotated drawing sheet showing the changes
Replacement drawing sheet including the changes

SUBSTITUTE SPECIFICATION
(Showing All Changes Made to the Specification in Published International Application No. PCT/SE2004/001047, Publication No. WO 2005/00367 A1)

A METHOD AND AN ARRANGEMENT FOR SUPPORTING VERTICALLY DEPENDING ELECTRICAL RESISTANCE ELEMENTS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

The present invention relates to a method and an arrangement for supporting vertically depending electrical resistance elements.

DESCRIPTION OF THE RELATED ART

Such resistance elements are used primarily to heat industrial furnaces or ovens. Each element ~~comprises~~ includes current conducting legs that run downwards and upwards a number of times. The top of the element merges with a number of terminals that are connected to one more sources of electric current. The element thus hangs from the roof of the furnace and extends downwards in operation. The legs are subjected to strong thermal variations in operation, due to the power developed therein. This variation results in bending or twisting of individual legs in the element as the temperature changes. Consequently, the element is provided along its length with a number of ceramic discs that include through-penetrating holes through which respective element legs extend. These ceramic discs are intended to hold the legs of the element apart and ~~therewith~~ out of contact with one another. Mutual contact of the legs would cause the element to short circuit, resulting in serious damage, if not destruction, of the resistance element.

The uppermost ceramic disc or the uppermost discs may also serve to support the weight of the resistance element. According to the present ~~standpoint of techniques~~ state of the art, this is achieved by coupling pairs of legs together with the aid of current conducting plates which rest on the uppermost ceramic disc or on the uppermost discs, depending on the geometry of the resistance element concerned. Legs thus extend pair-wise through a ceramic suspension disc and are joined together on the upper side of said disc through the medium of such a current conducting plate and supported in this way by the ceramic disc.

The power developed in the legs is often very high. Typical powers developed in the legs of a resistance element in industrial operation can be in the order of 20-50 kW. The resistance element is often driven cyclically, meaning that the temperature in the vicinity of the ceramic plates will vary over a wide temperature range in the space of time.

This heavy thermal load in combination with the mechanical load borne by the supportive ceramic discs results in the formation of cracks in said discs and finally in fracturing of the discs. When this occurs, the resistance element will no longer be supported by the broken discs and will collapse down into the furnace, ~~therewith~~ thereby resulting in significant repair costs.

A typical life span of a supporting ceramic disc is ~~in~~ of the order of three to six months.

An industrial furnace may include a considerable number of resistance elements, for example several hundred. This means that serious costs are often

incurred in changing or replacing supportive ceramic discs. It is therefore desirable to find a way of increasing the useful length of life of such discs.

SUMMARY OF THE INVENTION

Accordingly, the present invention relates to a method and to an arrangement for supporting vertically hanging electrical resistance elements for heating furnaces or ovens in industrial ~~operation, wherein each~~ operations. Each element ~~comprises~~ includes current conducting legs that run downwards and upwards a number of times, wherein the resistance element includes along its length a number of ceramic discs that are provided with holes through which respective element legs extend ~~, wherein the~~ . The upper part of ~~said~~ the element merges with terminals that are connected to a source of electric current ~~, wherein said~~ . The element is supported by at least one of the uppermost of ~~said~~ the ceramic discs, and ~~is characterised in that~~ the uppermost ceramic disc ~~or the uppermost ceramic discs~~ by which the element is supported ~~is/are~~ is placed in the roof insulation of the furnace above the underside of ~~said~~ the roof ~~; and in that~~ . The legs of the element are ~~caused to be~~ short circuited at a location slightly or somewhat beneath the underside of said roof with the aid of short circuiting plates.

The invention also relates to an ~~arrangement of the kind and with the general features set forth in the accompanying Claim 6~~ for carrying out the method.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be described in more detail with reference to a non-limiting exemplifying embodiment thereof and also with reference to Figure 1 , which

shows an elevational view of an embodiment of an electrical resistance support arrangement for supporting vertically depending resistance elements.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 illustrates a resistance element assembly 1 according to the present invention, mounted in a furnace 2. The resistance element assembly 1 extends through the roof insulation 3 of the furnace 2 and down into the heated furnace volume 4. The temperature in the heated volume 4 is extremely high and sometimes varies cyclically in the operation of the furnace. The temperature diminishes gradually upwards in the insulation 3 as seen in the Figure, down to essentially room temperature above the upper edge of the insulation 3.

The resistance element assembly 1 is driven through the agency of two terminals ~~5~~ 5a and 5b that are connected to an external source of electric current (not shown). The resistance element assembly 1 includes along its length a number of legs 6 which extend down into the heated volume 4 of the furnace and up again to the insulation 3 of the furnace 2. The legs 6 are coupled together in pairs with the aid of a number of ~~short-circuiting~~ connecting plates 7, which are preferably made of the same material as the legs themselves. These ~~short-circuiting~~ connecting plates 7 are situated below the lower surface 15 of the furnace roof.

One of the legs 6 is also coupled to the input terminal 5a and another of the legs 6 is coupled to the output terminal 5b. This allows current to flow in through the input terminal 5a, through all legs 6 and finally out through the output terminal 5b.

The number of terminals ~~5~~ 5a, 5b may be varied for different purposes, for instance to enable furnace power to be controlled. The terminals ~~5~~ 5a, 5b may also be connected to several external sources of electric current.

The legs 6 are preferably ~~comprised of~~ formed from FeCrAl.

In order to prevent short circuiting between the legs 6 when the temperature varies, a number of disc-shaped ceramic spacers 8 are ~~dispersed~~ spaced longitudinally along the length of the resistance element assembly 1, said ceramic spacers 8 being held in place by a central rod 9 extending through the resistance element assembly 1.

The ceramic spacers 8 are preferably ~~configured~~ formed from Al_2O_3, SiO_2, or a mixture thereof, these materials being electrically insulating.

The two uppermost ceramic discs 10, 11 are placed above the upper inner surface of the heated volume 4 of the furnace 2, and above lower surface 15 of the furnace roof, within the insulation 3 of the furnace roof 2. These uppermost ceramic discs 10, 11 serve to support the weight of the element assembly 1, in addition to functioning as spacer means between the legs 6. This weight supporting function is achieved by virtue of the legs 6 being coupled pair-wise with the aid of a number of ~~short-circuiting~~ supporting plates 12, 13, 14, which rest on the upper ~~surface~~ surfaces of ~~both~~ respective ones of ~~said~~ uppermost ceramic disks 10, 11.

Thus, as a result of the ~~short-circuiting~~ conducting plates 7 present in the heated furnace ~~space~~ volume 4, much less current will flow through that upper part of the legs 6 situated in the furnace roof insulation 3 than that which flows through those

lower parts of the legs 6 that are situated in the heated furnace volume 4 of the furnace 2.

~~Solely~~ Only the current that flows from the input terminal and through a leg down through the insulation 3 of the furnace 2 and the current that flows ~~through~~ from a leg through the insulation 3 of the furnace 2 and out through the output terminal contributes to the thermal development of power in the ~~legs in~~ leg portions that are within the region of the insulation 3 of the furnace 2.

Because the ceramic plates 12 are ~~comprised of~~ formed from an electrically insulating material, the power developed by the current passing through the legs and through the ceramic plates 12, in other words the current flowing through the legs above the upper surface of the heated volume 4 of the furnace 2, will be negligible.

The thermal load on the uppermost, supportive ceramic discs ~~8~~ 10, 11 is greatly reduced by virtue of the temperature in the insulation 3 of the furnace 2 being much lower than the temperature of the heated volume 4 of the furnace 2. The non-supporting ceramic discs 8 remain under thermal loading. Thus, the present invention circumvents the problem relating to the application of both thermal and mechanical loads to supportive ceramic discs.

The thermal load on the supportive ceramic discs ~~8~~ 10, 11 can be reduced still further, by placing said discs above the upper surface of the insulation 3 of the furnace 2, in other words externally of the furnace and therewith under essentially room temperature conditions.

In this way, the present invention increases the life span of the supportive ceramic discs from the normal three to six months applicable in the case of the present

~~standpoint of techniques~~ state of the art to from two to four years, thereby greatly reducing the ~~running~~ operating costs of this type of resistance element in industrial applications.

Moreover, because the thermal load on the supportive discs is reduced significantly, the discs can be given smaller dimensions according to the present invention than has been possible hitherto. In turn, this enables resistance elements to be given geometries that are novel or expanded with respect to geometries applicable to the present ~~standpoint of techniques~~ state of the art. Alternatively, larger resistance ~~elements~~ element assemblies can be constructed with the aid of the present invention due to the fact that the supportive discs are now able to withstand a greater load as a result of the substantial reduction in the thermal load on the discs.

Furthermore, the inventive electrical resistance element assembly can be ~~run~~ operated with a higher power than was possible with resistance elements according to the present ~~standpoint of techniques~~ state of the art, for the same reasons as those mentioned above.

Although the invention has been described above with reference to a number of embodiments thereof, it will be understood that ~~hese~~ those embodiments can be varied with respect to the type of element concerned, for instance.

The present invention ~~shall~~ is not therefore to be considered to be restricted to the embodiments indicated above since variations can be made within the scope of the accompanying claims.

~~Claims~~

What is claimed is:

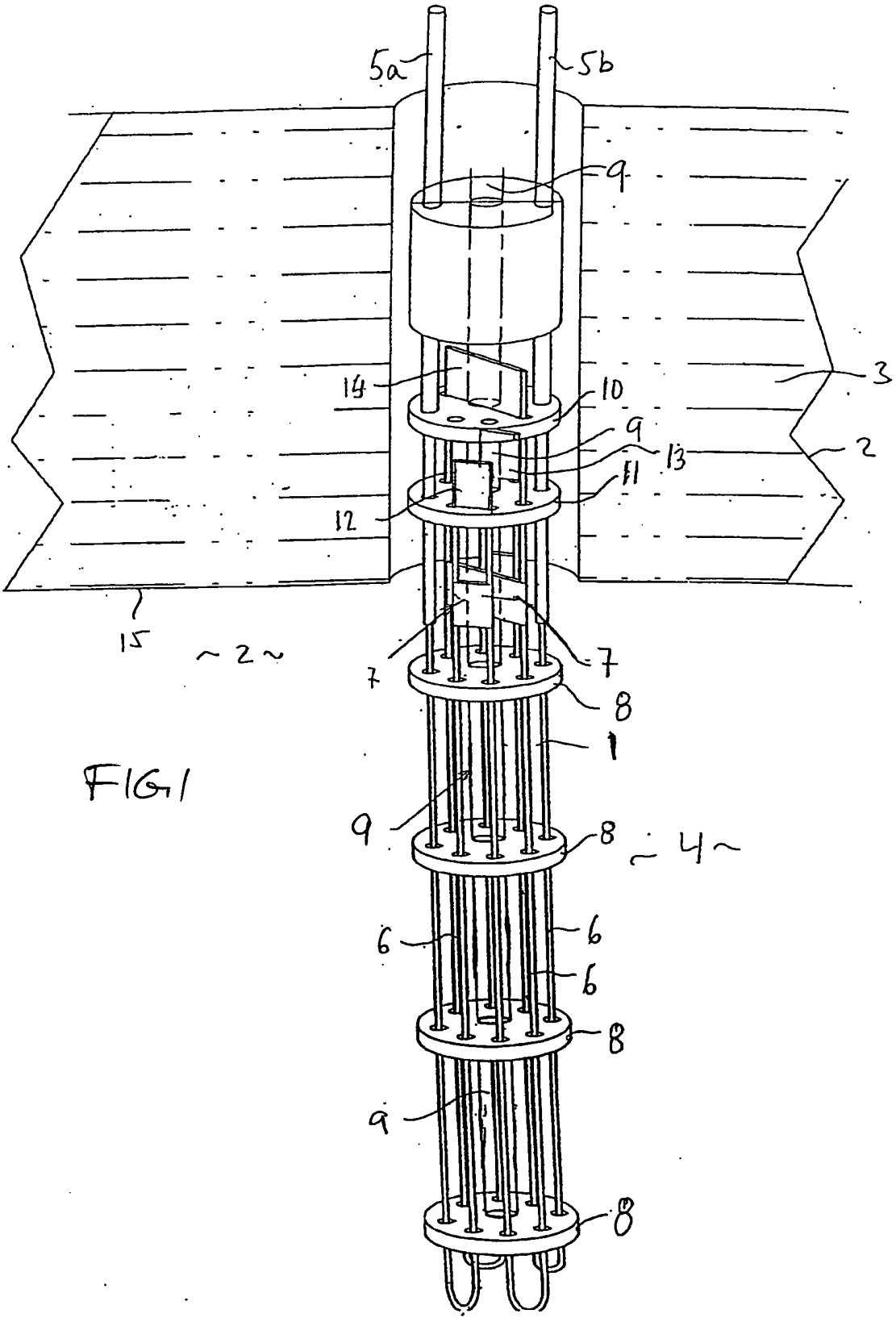

FIG1